DOCUMENT RESUME

ED 436 427 SE 063 054

AUTHOR Hutton, B. Meriel
TITLE Student Nurses and Mathematics.
PUB DATE 1997-07-00
NOTE 8p.; Paper presented at the Adults Learning Mathematics Conference (4th, Limerick, Ireland, July 4-6, 1997).
PUB TYPE Reports - Research (143)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computation; Foreign Countries; Higher Education; Mathematical Applications; *Mathematics Education; *Mathematics Skills; *Nurses; *Nursing Education; *Student Attitudes
IDENTIFIERS United Kingdom

ABSTRACT

For the safety of the public, it is essential that nurses are competent at least in the mathematics that enables them to calculate medications accurately. From a survey by G. Hek (1994), it is apparent that mathematics is not universally included in the nursing curricula, nor asked for as a pre-requisite to entry. Changes in the profile of the typical student nurse from a school leaver with 5 'O' levels to a more mature woman with often fewer school qualifications have been one of the triggers for this study into student nurses and mathematics. In this paper, students' feelings about mathematics are explored and related to age, time elapsed since leaving school, and performance on a test of nursing mathematics. Provision for revision and mathematics support is described and the results of a post-test are analyzed. The results indicate that pre-registration nursing courses should include an element of mathematics to alert students to their own shortcomings and provide a means to improve their computational skills before working in the clinical areas. (Contains 14 references.) (Author/ASK)

Reproductions supplied by EDRS are the best that can be made
from the original document.

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED 436 427

# Student Nurses and Mathematics

**B. Meriel Hutton**

**Faculty of Health and Community Care, University of Central England in Birmingham**

**Abstract**

For the safety of the public, it is essential that nurses are competent at least in the mathematics that enables them to calculate medications accurately. From a survey by Hek (1994) it is apparent that mathematics is not universally included in the nursing curricula, nor asked for as a pre-requisite to entry. Changes in the profile of the typical student nurse from a school leaver with 5 'O' levels to a more mature woman with often fewer school qualifications have been one of the triggers for this study into student nurses and mathematics.

In this paper, students' feelings about mathematics are explored and related to age, time elapsed since leaving school and performance in a test of nursing mathematics. Provision for revision and mathematics support is described and the results of a post-test analysed. The results indicate that pre-registration nursing courses should include an element of mathematics to alert students to their own shortcomings and provide a means to improve their computational skills before working in the clinical areas.

## Introduction

That nurses need to be competent in the mathematics involved in calculating fluid balance, drug dosages and intravenous drip rates is generally accepted. However, nursing students have been shown to perform poorly in written tests of the relevant mathematics (Whittaker 1987, Miller 1992, Hutton 1997). Students entering nursing in the 1990s represent a new type of student nurse. Gone is the image of the beginner nurse as an 18 year old school leaver, although these do still form a large proportion of the entry cohort. But a much wider wide range of adult learner is now the norm. Most are women, although the steady 10% of males which has been the case for several years is now approaching 14%, and the average age is around 25 years. The men tend to perform better than the women in the mathematics test and so I will not be considering them specifically in this paper. Many of the adult women are venturing on a career having already had families and bring with them a rich variety of life experiences. These women are often lacking in confidence in their mathematics ability and perform badly in the test for a number of reasons.

This paper seeks to explore these reasons and to look for useful ways in which to improve both the confidence levels and the performance in nursing mathematics by such students.

## The students

The students who contributed to this study were all enrolled on a Project 2000 Nursing course within a University. Cohorts are large, with over 100 students entering at one time and teaching generally tends to be to large groups. The Project 2000 course is a three year course



BEST COPY AVAILABLE

leading to a Diploma in Higher Education and entry ento the professional register in any one of the four branches comprising adult nursing, children's nursing, mental health nursing or nursing people with learning disabilities. Mathematics is included in the Common Foundation Programme as part of a general study skills module and so students from all branches of nursing are included.

**Feelings about mathematics**

The students were given a diagnostic test of nursing mathematics in their first week of the course so that revision sessions could be arranged as necessary. After they had done this test, I asked them to write a few lines on how they felt about mathematics and its inclusion in the nursing curriculum.

Most students recognised the need for at least basic arithmetic as a factor of nursing although one or two expressed surprise at its inclusion in the course. This was not unreasonable given that not all nursing courses do include mathematics (Hek 1994) and my own research has indicated that it is used much more in children's nursing and high tech areas of adult nursing than in either of the other two branches. Many students claimed to have forgotten all the relevant arithmetic since leaving school or excused themselves with statements such as;

> In school, the maths course is not aimed toward basic arithmetic. The core of the work is based on problem solving and theorems. So the adding and dividing etc.... of numbers and fractions are forgotten again then as they have not been taught since 11 or 12 years of age.

I think this suggests an element of what Lave (1988) termed situated learning, in that the mathematics learned in elementary school was considered to be different from the mathematics required to work out the problems set in senior school. This particular student was actually quite proficient in her performance in the test and was perhaps unconscious of the fact that she had utilised those mathematics skills which she thought were forgotten from an earlier age.

The very term 'mathematics' has been found to trigger fearful emotions in many people (Buxton 1981) and such 'mathophobia' was a common theme among the written statements, particularly from more mature women who appeared to have more insight into the dangers of making mistakes. A 30 year old wrote, I need to be good at maths or I could kill someone. Anxiety was even more obvious in relation to the test. When I tutored some of these women in small groups, using everyday examples, they were able to calculate the mathematics without any problems. They needed to be able to relate the mathematics to real life in order to make sense of it. They were encouraged to form their own groups in which to work on the revision and to discuss different ways of doing calculations. In spite of the contentions of these women that they could not do mathematics, the older age group in fact scored higher marks in the test then their younger colleagues.

The more recent school leavers were more confident about their ability to cope with nursing mathematics after some revision and particularly if they were allowed to use calculators (see my paper entitled 'Should Nurses Carry Calculators' also in this volume). They were more keen to work individually and were more likely to use school taught methods of calculating.

**Provision for revision**

The diagnostic test showed that on paper at least, many of the students required some revision in basic arithmetic of the type used in nursing mathematics and some practice in interpreting word problems covering calculations which they might be required to do in practice. Pirie's (1982) research had suggested that self-help books were of most use to student nurses given the time constraints of the curriculum. Although her suggestions were made over 10 years ago, the nursing curriculum now has even less time in it for mathematics and so booklets were devised to provide self-instruction backed up by group tutorials as required.

Students were encouraged to form their own groups for revision work, a suggestion taken up only by a very small number of mature women. These women had all performed badly in the test but were able to verbalise sensible solutions to the problems and seemed to be able to perform the necessary mathematics when relaxed, in a away that was not apparent from their test results. The drawback in this arrangement was the slow progress they made through the required material which meant that they could not cover it all by the time of the post-test. The positive results were the development of group dynamics in which peer support was very evident and the obvious enthusiasm towards learning mathematics which these women showed.

**Post-test results**

The results of the post-test showed an improvement overall in both the younger students and the more mature group, although the older students showed less of an increase. See Table 1. Those who had admitted to maths anxiety performed least well, although they too improved.

| Age group | Age mean (SD) | Pre-test score mean (SD) | Post-test score mean (SD) | Difference in scores mean (SD) |
|---|---|---|---|---|
| 21 and under n = 106 | 19.7 (1.1) | 20.07 (6.4) | 28.79 (7.8) | 9 (6) |
| 22 and over n = 78 | 29 (6.2) | 23.08 (6.8) | 30.1 (8.4) | 7 (6) |

**Table 1: Pre and post-test scores by age group**

**Discussion**

Some students were still scoring poorly in the test even after the revision sessions and so were invited to attend tutorials on a one-to-one basis where the test was discussed. Those who did come for tutorial help were able to vocalise their problems and demonstrated a performance failure rather than an inherent inability to comprehend the mathematics concerned. All these students were female and the majority were mature students. They all felt under pressure in the test and voiced variations on the theme of maths anxiety already mentioned. Sadie, a 30 year old, said, 'I saw the questions and just froze.' Such comments were common within this group. On an individual basis these women demonstrated remarkably high performance in mental

calculation which calls to question the validity of such assessment methods when trying to establish a true picture of mathematical ability in student nurses. When I went through the test in the tutorial, few of the test items could not be done correctly and a typical remark was that of a 28 year old student who said, 'now when I look at it, I know how to do them, but it just went out of my head at the time.'

The students showed a variety of strategies to reach the answers, many of which they could not explain, but just 'knew' . This was an example of the type of common-sense knowing in mathematics described by Coben (1996). Only one student showed any signs of panic in the one-to-one situation, reinforcing my feelings that this, or indeed any written test was not a good indicator of some students' competence at calculation. I had tried to limit the effect of anxiety on performance in the test by making the atmosphere relatively informal and stressing to the students that this test did not constitute part of their formal assessment and was simply to identify those who needed additional help in mathematics for nursing. However, given the constraints of time allocated, numbers of students and type of accommodation, I felt that there was no workable alternative method of identifying those in need of revision.

Mathematics was not taught again in the course as a subject in its own right, although some time was given to a session covering units of measurement used within nursing and another on drug administration which included specific nursing calculations, including formulae for drip rates and drug dosages.

**Where from here?**

The student nurses were not all competent in nursing mathematics by the time they had completed the study skills module. They had been selected as representative of the population of student nurses and so it could be assumed that this was not an uncommon occurrence. I knew from observation that mathematics was used extensively in nursing and now knew that the student nurses appeared to be poor performers in nursing mathematics. Why, therefore were the papers not full of the consequences of mathematics errors? How did the students learn to become competent in the necessary mathematics?

I believe that the acquisition of competency in nursing mathematics comes, not through classroom tuition, but through using the relevant skills in the appropriate situation. Although this may be argued as an example of culture-bound learning as in Lave's (1988) grocery shoppers, it may also be an example of initially contextualised learning leading to unconscious use of the background skills then being applied to a different situation. It is in recognising the similarities of different situations that learning is enhanced. Students who I interviewed near the end of their training told me that the maths they had done in the classroom made no sense at all and was forgotten . It was only when they had to *do* the calculations on the ward that it began to make sense.

I applied Knowles' (1980) androgogical model of adult learners to the student nurses in order to identify where their learning of nursing mathematics fitted. Knowles' four assumptions of andragogy are:

1. Adults both desire and enact a tendency toward self-directedness as they mature, though they may be dependent in certain situations.

2. Adults' experiences are a rich resource for learning. Adults learn more effectively through experiential techniques of education such as discussion and problem solving.

3. Adults are aware of specific learning needs generated by real life tasks or problems. Adult education programs, therefore, should be organised around 'life-application' categories and sequenced according to learners' readiness to learn.

4. Adults are competency based learners in that they wish to apply newly acquired skills or knowledge to their immediate circumstances. Adults are, therefore, 'performance-centred' in their orientation to learning.

(Knowles 1980, pp 43-44)

**Self-directed learning**

The student nurses began their self-directed learning of nursing mathematics by using the booklets supplied for revision, but this was only a beginning. The maths testing, however unrealistic as a real measure of nurses' competency in mathematics in view of the anxiety factor and contextuality of the test, highlighted individuals' needs. The students could identify their own deficits of learning and were therefore equipped to seek remediation. The self-direction now being the motivation to do so.

**Experiential learning**

The second assumption of andragogy involves experience, both drawing on the experience of adult learners as a resource and also the provision of suitable experience from which they may learn. The nature of learning through experience is claimed to result in the development of concepts which are *'derived from and continuously modified by experience'* (Kolb in Thorpe et al, 1993, p144) and thought to make learning more meaningful than passive learning by rote. However, since new knowledge always builds on and makes use of previously acquired information, it follows that theoretical grounding given before or during experience will make that experience more meaningful still. Schön's (1987) terminology of 'reflection-in-action' describes this concept of learning in contrast with 'reflection-on-action' which he uses to refer to learning analysed after the event. However, both are identified as valuable sources of experiential learning in professional education.

The more senior students who had had experience of clinical placements were the ones who had told me that they only learned the necessary mathematics when they had to *do* it. Some

recognised that the mathematics highlighted by the original test was in fact what they were using in practice. Other students failed to make any connection between the two, possibly because they had never lost these skills or maybe because their initial learning was truly 'situated' and they saw the mathematics used in the clinical area as different and new. Therefore, the student nurse needs exposure to nursing mathematics in a practical situation to continue the motivation to learn and to consolidate the classroom tuition.

**Situated learning**

This concept seemed to fit around the third assumption of andragogy if real-life situations are taken to be a specific cultural context. Real-life for the nursing students was the clinical situation. Some students recognised that the mathematics they were using was what had been taught in the classroom and the children's nursing branch specifically made use in practice of the algorithms introduced in college. In other areas of practice where the use of specific formulae was not apparent, they were quickly forgotten and logic or common-sense strategies took over. The students who learned in this way had less difficulty when they were faced with new situations which did not match the learned formula. Student nurses need encouragement not to learn by rote, but to understand the underlying concepts and to recognise the similarities between different contexts where the same mathematics is being used. This is a particular problem for students whose ward-based teachers are other nurses whose culture is even more bound up in the activities of that particular ward than the more peripatetic student. The student is in a much more difficult position than the trained nurse from the point of view of mathematical competency. The student has to apply knowledge acquired in different contexts to all the different situations she may come across during a variety of clinical placements. The trained nurse is usually attached to a specific ward or unit where the culture remains relatively static. This could be one explanation of why the apparent poor performance in nursing mathematics in student nurses is not mirrored by trained staff. The mathematics used by qualified staff is consolidated by experience in a stable context and so becomes common-sense within everyday routine.

**Competency-based learning**

It is argued by Benner (1984) and reiterated by Ashworth and Saxton (1990) that professional competency is highly situational and context-dependent rather than consisting of generalisable knowledge and skills. Although nursing mathematics forms a very small element of the competencies required of a nurse, it needs to be seen in context and should therefore be tested in the practical situation rather than as a paper and pen exercise in a classroom. I would suggest that the variety of experiences included in a student's training, combined with reflection on the experiences, will facilitate the development of competency which will prepare the student to become an expert in the area she eventually settles. This will become more context-bound as she concentrates on a particular speciality, but her basic training should provide sufficient experience for her to be able to make a choice. The concept of competence developing through a variety of different experiences is supported by the work of Dall'Alba and Sandberg (1995) who advocate changing ways of students' experiencing practice in order to encourage a broader view of knowledge.

**Conclusions**

This paper has explored briefly the feelings of beginner student nurses in relation to mathematics in the nursing curriculum. The findings are discussed with reference to the students' age and time since leaving school and a greater level of anxiety shown in more mature students, particularly women. Provision for revision is discussed and an analysis of the post-test results. In finding that many students are still lacking the necessary competency in nursing mathematics, I went on to look at how they fitted the model of andragogy presented by Knowles(1980) which offers an explanation of how competency in nursing mathematics is acquired.

Nurse educators must ensure that the student is given the opportunity of exposure to different clinical environments and encouraged to reflect on the experiences in order to develop competency which is not totally context-bound .

**References:**


Ashworth P.D., Saxton J. (1990) On 'Competence' Journal of Further and Higher Education 14:2 pp 3-25

Benner P. (1984) From Novice to Expert: Excellence and power in Clinical Nursing Practice Menlo Park CA : Addison-Wesley.

Buxton L.(1981) Do You Panic About Maths? Coping with Maths Anxiety London : Heinemann Educational.

Coben D.(1996) 'Mathematics and Common Sense' ALM-3 Proceedings of the Third International Conference of Adults Learning Maths - a Research Forum London: Goldsmiths College, University of London in conjunction with ALM.

Dall'Alba G., Sandberg J.(1995)' Educating for competence in professional practice. ' Proceedings of the conference of the European Association for Research on Learning and Instruction (EARLI) Nijmegen, The Netherlands, August 1995.

Hek G.(1994) 'Adding up the cost of teaching mathematics' Nursing Standard 8:22,25-9

Hutton B.M.(1997) 'Do school qualifications predict competency in nursing calculations' Nurse Education Today, 17 (in press)

Knowles M.S. (1980) The Modern Practice Of Adult Education: From Pedagogy To Andragogy.(2nd ed) New York : Cambridge Books.

Lave J. (1988) Cognition in Practice Cambridge : Cambridge University Press.

Miller J.(1992) 'Can Nurses do their Sums?' Nursing Times 5/8/92 p58 -- 59

Pirie S. (1982) Deficiencies in basic mathematical skills among nurses: development and evaluation of methods of detection and treatment. Unpublished PhD thesis, University of Nottingham

Schon D.A. (1987) Educating the reflective practitioner: Toward a new design for teaching and learning in the professions San Francisco : Jossey-Bass.

Thorpe M., Edwards R., Hanson A. [Eds](1993) Culture and Processes of Adult Learning: a reader London : Routledge.

Whittaker N.( 1987) 'Finding the right answer ' Senior Nurse 6,6 p33